Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method of operating a micro-mechanical or nano-mechanical device comprising a resonator and a piezoresistive element connected to the resonator, the method comprising:

AC biasing the piezoresistive element at a first frequency;

driving the resonator at a second frequency different from the first frequency; [[and]]

detecting a mechanical response of the resonator at one or both of a difference frequency and a sum frequency of the first and second frequencies; and

AC biasing a resistor at the first frequency and detecting an output signal at a bridge point between the resistor and the micro-mechanical or nano-mechanical device.

2. (Original) The method of claim 1, wherein the step of detecting comprising determining an amount of mechanical displacement of the resonator.

3. (Original) The method of claim 1, wherein the step of driving the resonator comprises oscillating the resonator using an AC drive source at the second frequency, which comprises the resonator's resonant frequency.

4. (Original) The method of claim 1, wherein the second frequency comprises a resonance frequency of the resonator which is less than the first frequency.

5. (Original) The method of claim 4, wherein the step of detecting comprises detecting a mechanical response of the resonator at a difference of the first and second frequencies.

6. (Canceled)

7. (Currently Amended) The method of claim [[6]] 1, wherein the step of AC biasing comprises providing an AC biasing voltage across the piezoresistive element and the resistor at the first frequency and the step of detecting the output signal comprises detecting

an output voltage which is a function of a frequency difference between the first and the second frequencies.

8. (Original) The method of claim 7, wherein the output voltage comprises

$$V_{out}(t) \approx \frac{V_{b0}\cos(\omega_b t)}{4R}\left(\Delta R\cos(\omega_d t + \phi)\right) \approx V_{b0}\frac{\Delta R}{8R}\left[\cos(\Delta\omega t - \phi) + \cos\left((2\omega_d + \Delta\omega)t + \phi\right)\right].$$

, where R is a resistance of the resistor, ΔR is a difference between a resistance of the resistor and a resistance of the piezoresistive element, Δω is a difference between the first and the second frequencies, V_{b0} is the AC biasing voltage, ϕ is an oscillation phase and t is time.

9. (Original) The method of claim 8, wherein the step of detecting comprises providing the output voltage into a phase sensitive detector.

10. (Previously Presented) The method of claim 9, further comprising mixing the AC biasing voltage and an AC drive voltage used to drive the resonator, and providing a mixed voltage into the phase sensitive detector, which comprises a lock-in amplifier, as a reference voltage.

11. (Original) The method of claim 1, wherein the device comprises an entire or a portion of a NEMS.

12. (Currently Amended) The ~~system~~ method of claim 11, wherein the NEMS comprises at least one of a mass sensor, a charge sensor, a force sensor, a pressure sensor, a flow sensor, a chemical sensor, a biological sensor, an inertial sensor and a biological imaging device.

13. (Original) The method of claim 1, wherein the device comprises an entire or a portion of a MEMS.

14. (Original) The method of claim 1, wherein the device is located in an AFM system and the resonator comprises an AFM probe.

15. (Original) The method of claim 14, further comprising at least one of determining or imaging characteristics of a surface being examined by the AFM probe based on a piezoresistive response of the piezoresistive element.

16. (Original) The method of claim 1, wherein the piezoresistive element comprises a metal film.

17. (Original) The method of claim 1, wherein the piezoresistive element comprises a semiconductor film.

18. (Original) The method of claim 1, wherein the resonator comprises a cantilever.

19. (Original) The method of claim 1, wherein the resonator is selected from a group consisting of a torsional resonator, a doubly clamped beam and a diaphragm resonator.

20. (Currently Amended) A system, comprising:

a micro-mechanical or nano-mechanical device comprising resonator and a piezoresistive element connected to the resonator;

an AC bias source electrically connected to the piezoresistive element and adapted to AC bias the piezoresistive element at a first frequency;

an AC drive source operatively connected to the resonator and adapted to drive the resonator at a second frequency different from the first frequency; [[and]]

a phase sensitive detector comprising a lock-in amplifier, the detector is electrically connected to the piezoresistive element and adapted to detect a mechanical response of the resonator at one or both of a difference frequency and a sum frequency of the first and second frequencies, and

a resistor,

wherein the AC drive source is a) electrically connected to a piezoactuator, which is adapted to oscillate the resonator the second frequency which comprises a resonant frequency of the resonator, and b) adapted to provide a first voltage having the first frequency to both the piezoresistive element and to the resistor.

21. (Canceled)

22. (Currently Amended) The system of claim [[21]] 20, wherein the step of detecting comprises detecting a mechanical response of the resonator at a difference of the first and second frequencies.

23-25. (Canceled)

26. (Currently Amended) The system of claim [[25]] 20, further comprising a first low pass filter whose output is electrically connected to an input of the lock-in amplifier and whose input is connected to a bridge point between the resistor and the micro-mechanical or nano-mechanical device.

27. (Original) The system of claim 26, further comprising a mixer whose first input is electrically connected to an output of the AC bias source, whose second input is electrically connected to an output of the AC drive source, and whose output is electrically connected via a second low pass filter to a reference input of the lock-in amplifier.

28. (Original) The system of claim 20, wherein the resonator is selected from a group consisting of a torsional resonator, a doubly clamped beam and a diaphragm resonator.

29. (Original) The system of claim 20, wherein the resonator comprises a cantilever.

30. (Original) The system of claim 29, wherein the cantilever comprises a notch and leg portions surrounding the notch, and the piezoresistive element comprises a piezoresistive film located at least on the leg portions of the cantilever.

31. (Original) The system of claim 30, wherein the cantilever comprises an inorganic material.

32. (Original) The system of claim 30, wherein the piezoresistive element comprises a metal film located on a surface of the resonator.

33. (Original) The system of claim 30, wherein the piezoresistive element comprises a semiconductor film located on a surface of the resonator.

34. (Original) The system of claim 30, wherein the device comprises an AFM probe containing an AFM tip on a first surface of the cantilever.

35. (Original) The system of claim 20, wherein the device comprises an entire or a part of a MEMS or NEMS selected from a group consisting of a SPM probe, a mass sensor, a charge sensor, a force sensor, a pressure sensor, a flow sensor, a chemical sensor, a biological sensor, an inertial sensor and a biological imaging device.

36. (Original) The system of claim 20, wherein the device is made by a method comprising:

forming at least one release region adjacent to the device;

forming a membrane at least partially surrounding the device;

forming a plurality of support beams connecting the device to a substrate;

removing the at least one release region to form at least one gap adjacent to the device;

using the at least one gap region to remove the device from the substrate by breaking the plurality of support beams and the membrane.

37. (Original) The system of claim 36, wherein the method further comprises patterning a portion of the membrane to form a cantilever after forming the support beams but prior to removing the at least one release region.

38. (Canceled)

39. (New) A method of operating a micro-mechanical or nano-mechanical device comprising a resonator and a piezoresistive element connected to the resonator, the method comprising:

AC biasing the piezoresistive element at a first frequency;

driving the resonator at a second frequency different from the first frequency; and

detecting a mechanical response of the resonator at one or both of a difference frequency and a sum frequency of the first and second frequencies, wherein the device comprises an entire or a portion of a NEMS.

40. (New) The method of claim 39, wherein the step of detecting comprising determining an amount of mechanical displacement of the resonator.

41. (New) The method of claim 39, wherein the step of driving the resonator comprises oscillating the resonator using an AC drive source at the second frequency, which comprises the resonator's resonant frequency.

42. (New) The method of claim 39, wherein the second frequency comprises a resonance frequency of the resonator which is less than the first frequency.

43 (New) The method of claim 42, wherein the step of detecting comprises detecting a mechanical response of the resonator at a difference of the first and second frequencies.

44. (New) The method of claim 45, wherein the output voltage comprises

$$\begin{aligned} V_{out}(t) &\approx \frac{V_{b0}\cos(\omega_b t)}{4R}\left(\Delta R\cos(\omega_d t + \phi)\right) \\ &\approx V_{b0}\frac{\Delta R}{8R}\left[\cos(\Delta\omega t - \phi) + \cos\left((2\omega_d + \Delta\omega)t + \phi\right)\right]. \end{aligned}$$

, where R is a resistance of the resistor, ΔR is a difference between a resistance of the resistor and a resistance of the piezoresistive element, Δω is a difference between the first and the second frequencies, V_{b0} is the AC biasing voltage, ϕ is an oscillation phase and t is time.

45. (New) The method of claim 46, wherein the step of detecting comprises providing the output voltage into a phase sensitive detector.

46. (New) The method of claim 47, further comprising mixing the AC biasing voltage and an AC drive voltage used to drive the resonator, and providing a mixed voltage into the phase sensitive detector, which comprises a lock-in amplifier, as a reference voltage.

47. (New) The method of claim 39, wherein the NEMS comprises at least one of a mass sensor, a charge sensor, a force sensor, a pressure sensor, a flow sensor, a chemical sensor, a biological sensor, an inertial sensor and a biological imaging device.

48. (New) The method of claim 39, wherein the device is located in an AFM system and the resonator comprises an AFM probe.

49. (New) The method of claim 48, further comprising at least one of determining or imaging characteristics of a surface being examined by the AFM probe based on a piezoresistive response of the piezoresistive element.

50. (New) The method of claim 39, wherein the piezoresistive element comprises a metal film.

51. (New) The method of claim 39, wherein the piezoresistive element comprises a semiconductor film.

52. (New) The method of claim 39, wherein the resonator comprises a cantilever.

53. (New) The method of claim 39, wherein the resonator is selected from a group consisting of a torsional resonator, a doubly clamped beam and a diaphragm resonator.

54. (New) A system, comprising:

a micro-mechanical or nano-mechanical device comprising resonator and a piezoresistive element connected to the resonator;

an AC bias source electrically connected to the piezoresistive element and adapted to AC bias the piezoresistive element at a first frequency;

an AC drive source operatively connected to the resonator and adapted to drive the resonator at a second frequency different from the first frequency; and

a phase sensitive detector electrically connected to the piezoresistive element and adapted to detect a mechanical response of the resonator,

wherein the device comprises an entire or a part of a MEMS or NEMS selected from a group consisting of a SPM probe, a mass sensor, a charge sensor, a force sensor, a pressure sensor, a flow sensor, a chemical sensor, a biological sensor, an inertial sensor and a biological imaging device.

55. (New) The system of claim 54, wherein the detector is adapted to detect a mechanical response of the resonator at one or both of a difference frequency and a sum frequency of the first and second frequencies.

56. (New) The system of claim 55, wherein the step of detecting comprises detecting a mechanical response of the resonator at a difference of the first and second frequencies.

57. (New) The system of claim 55, wherein the AC drive source is electrically connected to a piezoactuator which is adapted to oscillate the resonator the second frequency which comprises a resonant frequency of the resonator.

58. (New) The system of claim 57, wherein the detector comprises a lock-in amplifier.

59. (New) The system of claim 58, further comprising a resistor, wherein the AC bias source is adapted to provide a first voltage having the first frequency to both the piezoresistive element and to the resistor and a first low pass filter whose output is electrically connected to an input of the lock-in amplifier and whose input is connected to a bridge point between the resistor and the micro-mechanical or nano-mechanical device.

60. (New) The system of claim 59, further comprising a mixer whose first input is electrically connected to an output of the AC bias source, whose second input is electrically connected to an output of the AC drive source, and whose output is electrically connected via a second low pass filter to a reference input of the lock-in amplifier.

61. (New) The system of claim 54, wherein the resonator is selected from a group consisting of a torsional resonator, a doubly clamped beam and a diaphragm resonator.

62. (New) The system of claim 54, wherein the resonator comprises a cantilever.

63. (New) The system of claim 62, wherein the cantilever comprises a notch and leg portions surrounding the notch, and the piezoresistive element comprises a piezoresistive film located at least on the leg portions of the cantilever.

64. (New) The system of claim 62, wherein the cantilever comprises an inorganic material.

65. (New) The system of claim 62, wherein the piezoresistive element comprises a metal film located on a surface of the resonator.

66. (New) The system of claim 62, wherein the piezoresistive element comprises a semiconductor film located on a surface of the resonator.

67. (New) The system of claim 62, wherein the device comprises an AFM probe containing an AFM tip on a first surface of the cantilever.